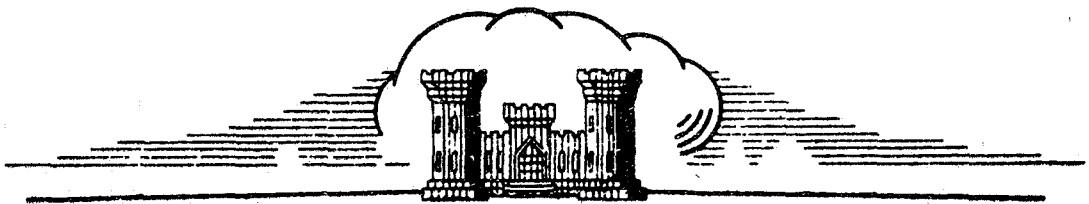


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NARRAGUAGUS RIVER

MAINE

PRELIMINARY EXAMINATION FOR FLOOD CONTROL



NEW ENGLAND DIVISION
CORPS OF ENGINEERS-WAR DEPARTMENT
BOSTON, MASS. 22, SEPT. 1947

WAR DEPARTMENT
CORPS OF ENGINEERS
OFFICE OF THE DIVISION ENGINEER
NEW ENGLAND DIVISION
31 ST. JAMES AVENUE
BOSTON 16, MASS.

22 September 1947

SUBJECT: Preliminary Examination for Flood Control,
Narraguagus River, Maine.

TO: The Chief of Engineers, War Department, Washington 25, D. C.

ATTENTION: ENGWF.

SYLLABUS

The Division Engineer finds that ice jam floods on the Narraguagus River have caused considerable damage in Cherryfield, Maine, and that there is urgent need for protection. He further finds that there is sufficient justification to warrant further consideration of permanent works of improvement or annual preventive measures. He recommends that a survey be made to determine a suitable plan for preventing and controlling ice jam floods on the Narraguagus River at Cherryfield, Maine.

1. Authority. - This report is submitted in compliance with Section 11 of the Flood Control Act approved 24 July 1946, Public Law 526 - 79th Congress, 2d Session, which provides that:

"The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys for flood control and allied purposes, including channel and major drainage improvements, and floods aggravated by or due to wind or tidal effects, to be made under the direction of the Chief of Engineers, in drainage areas of the United States and its territorial possessions, which include the following-named localities, * * * *:

Narraguagus River and tributaries, Maine."

2. Prior Reports. - No prior reports on flood control have been made on the Narraguagus River.

3. Description. - The Narraguagus River Basin lies in Hancock and Washington Counties in northeastern Maine, approximately 20 miles north-eastern Maine, approximately 20 miles northeast of Bar Harbor and 30 miles east of Bangor. The drainage basin is approximately 35 miles long with a maximum width of about 16 miles and a minimum width of three miles except at its southern extremity where it narrows to about two miles. The drainage area of 240 square miles includes nearly five square miles of lakes and ponds and 16 square miles of swamp and marsh land.

4. The topography of the basin is characterized by broad, rolling, or almost flat lowlands, with large areas of swamps and lakes. Isolated peaks are scattered throughout the basin and rise from 920 to 1475 feet above mean sea level along the limits of the watershed. The lower part of the basin includes small areas of cultivated land and extensive blueberry fields while the upper part is woodland and visited only by lumbermen and sportsmen. The lowlands and numerous hills are the surface expression of the gravelly sand and clay overburden of the glacial period which has almost completely obliterated the former bedrock drainage pattern. The present drainage is the result of an irregular overflow through the glacial overburden and very little systematic drainage has been developed. Consequently there is considerable natural storage and storm runoff is low. No geological investigations have been made within the basin but from explorations in adjacent watersheds it is expected that the bedrock is largely slate and sandstone.

5. The Narraguagus River is a coastal stream that rises in Eagle Lake, Township 34, Hancock County, Maine, flows in a general south-southeasterly direction through rolling country for a distance of about 49 miles, and empties into Narraguagus Bay and the Atlantic Ocean about 20 miles northeast of Bar Harbor, Maine. The total fall of the river is 406 feet. For the first 16 miles below Eagle Lake the fall averages over six feet per mile. In the next ten miles downstream it drops a

total of approximately 140 feet, then at Deblois occurs a fall of 40 to 50 feet in about a half-mile. Thence for a distance of about 15 miles the slope averages approximately 4.7 feet per mile to a point just above the village of Cherryfield where a steep drop of about 40 feet is experienced within a distance of a mile. Five rock-filled timber dams were once located within this section of the river at Cherryfield but all have been destroyed and are no longer in existence. (See Paragraph 25.)

Below Cherryfield the river is tidal with ranges of from three to seven feet at Cherryfield and 10 to 14 feet at its mouth just below Millbridge.

6. The principal and only important tributary of the Narraguagus River is the West Branch which drains 80 square miles in the southwestern portion of the basin and enters the Narraguagus two miles above the village of Cherryfield, and about 8.4 miles above its mouth. This tributary has a fall of about 350 feet in its 22.5-mile length. It is especially steep in its upper 3.3 miles where it has a slope of approximately 62 feet per mile. Numerous small streams and brooks with relatively steep slopes also feed into the Narraguagus River and its West Branch.

7. The Narraguagus River and its drainage basin are shown on standard quadrangle sheets of the U. S. Geological Survey, scale of 1:62,500, and on maps accompanying this report. The lower eight miles of the river are indicated on U. S. Coast and Geodetic Survey Chart No. 305 which shows the depths in the river up to Millbridge.

8. Economic Development. - The population of the entire basin is between 2,400 and 2,500. The largest towns in the watershed are Millbridge and Cherryfield with centers located about two miles and seven miles above the mouth, respectively. The population and real estate valuations of these two towns are shown below.

<u>Year</u>	<u>Millbridge</u>		<u>Cherryfield</u>	
	<u>Population</u>	<u>Valuation</u>	<u>Population</u>	<u>Valuation</u>
1900	1921	\$469,800	1859	\$518,700
1910	1550	429,600	1499	468,700
1920	1196	483,600	1304	486,900
1930	1207	487,200	1111	456,500
1940	1318	460,600	1046	417,000

Large portions of nine other towns are located in the basin. These towns are sparsely settled having a combined population of less than 100.

9. The decline in population during the past 40 to 50 years is due mainly to the curtailment of lumbering and allied operations in this vicinity. Two seafood canneries and several shell-fish dealers are now located at Millbridge. The present industries of Cherryfield consist of two blueberry canning factories, several lumber mills, and a recently established factory producing hypodermic needles. The accommodation of tourists, especially those interested in hunting and fishing, is one of the principal occupations of residents within the watershed.

10. Millbridge and Cherryfield are both located on U. S. Highway No. 1. Above Cherryfield there are only a few improved highways in the basin. Cherryfield is also served by the Washington County Railroad, a branch line of the Maine Central Railroad. Millbridge can be reached by water by light draft vessels.

11. Climatology. - The climate of the Narraguagus River Basin is dominated by its proximity to the Atlantic Ocean. The average January temperature is about 20° F. and the average July temperature about 66° F. Average temperatures over the basin range from 22° F. along the coast to 18° F. in the northern part during January and from about 65° F. to 68° F. for the same locations in July. The first freezing weather can be expected by September 30th and freezing temperatures are likely to prevail until the end of April or early in May. The following table lists the average mean monthly temperatures as estimated from the past 16 years of record at four stations adjacent to the basin.

TABLE I
MONTHLY TEMPERATURE RECORD
NARRAGUAGUS RIVER BASIN, MAINE

(Degrees Fahrenheit)*

<u>Month</u>	<u>Coast</u>	<u>Inland</u>	<u>Basin</u>
Jan	22.3	18.1	20.2
Feb	22.9	19.5	21.2
Mar	31.6	30.2	30.9
Apr	40.9	41.8	41.4
May	51.5	53.9	52.7
June	59.3	62.6	60.9
July	64.6	68.0	66.3
Aug	64.8	66.8	65.8
Sep	58.1	58.5	58.3
Oct	48.6	47.8	48.2
Nov	38.4	36.2	37.3
Dec	25.4	21.9	23.7
Annual	44.1	43.8	43.9

* Estimated from records for Bar Harbor, Eastport,
Oldtown and Woodland, Maine, 1931 to 1946.

The average March temperature has been exceeded five times during the past 16 years, in 1931, 1936, 1942, 1945 and 1946, when the averages were from 2° F. to 5° F. above freezing. The average temperature for the first ten days of March has been 27° F. This average has been above 32° F. only twice since 1931, in 1942 and 1946 when temperatures averaging about 35° F. were experienced.

12. The average annual precipitation is about 42 inches and this is distributed fairly uniformly throughout the year. There are no precipitation stations in the basin but statistics at various stations within 33 to 66 miles of the geographic center of the basin, having records of from 18 to 72 years, furnish data to indicate the conditions over the watershed. The estimated monthly precipitation records for the basin are summarized in the following table.

TABLE II

MONTHLY PRECIPITATION RECORD
NARRAGUAGUS RIVER BASIN, MAINE

(Depth in Inches)*

Maximum						Minimum					
Month	Inches	Year	Inches	Year	Mean	Month	Inches	Year	Inches	Year	Mean
Jan	9.3	1935	0.6	1944	3.5	July	5.4	1938	1.3	1935	2.8
Feb	8.5	1920	1.4	1941	2.9	Aug	6.3	1922	1.1	1944	3.0
Mar	7.4	1936	1.2	1924	3.7	Sept	8.0	1940	1.2	1923	3.9
Apr	7.3	1923	1.0	1941	3.8	Oct	8.1	1943	1.0	1924	4.3
May	7.3	1945	1.2	1944	2.8	Nov	7.3	1943	0.9	1939	3.9
June	7.1	1942	1.1	1941	3.4	Dec	7.6	1936	1.2	1943	3.5
						Annual	52.8	1936	31.7	1941	41.5

* Estimated from records for Oldtown, Ellsworth, and Woodland, Maine, 1920 to 1946, and for Machias, Maine, 1927 to 1946.

13. The amount of precipitation over the watershed during periods of heavy rainfall, and during periods just prior to floods of record, are listed below.

Month & Year	1st Period		2nd Period		Total Inches
	Dates	Inches	Dates	Inches	
May 1945	10 to 11	1.9	13 to 19	3.3	5.2
Sept. 1944	13 to 15	4.0	-	-	4.0
Oct. 1943	16 to 17	3.5	19 to 20	1.3	4.8
June 1942	15 to 17	5.5	-	-	5.5
March 1942/	3 to 7	2.4	9	2.4	4.8
April 1940	12 to 13	3.8	-	-	3.8
March 1936/	12 to 13	2.6	18 to 21	2.1	4.7
Sept. 1934	17	0.5	18	4.2	4.7
Oct. 1932	27	2.3	28	1.9	4.2
April 1923/	28 to 30	4.2	-	-	4.2
April 1923/	1 to 30	7.3	-	-	7.3

/ Years of flood occurrences.

14. The average annual snowfall over the basin for the past 25 years is about 68 inches as estimated from actual records at five stations outside the watershed limits, with an estimated maximum depth of 122 inches during the winter of 1922-23 and a minimum depth of 37 inches in the winter of 1932-33. During the winters preceding the 1936 and 1942 floods the depths of snowfall were approximately 63 inches and 57 inches, respectively, nearly 5 inches and 11 inches below the average.

15. Stream Flow Records. - There are no records of stream flow as gaging stations have not been installed on the Narraguagus River. A recording stream gaging station at Amherst, Maine, on the West Branch Union River, which adjoins the Narraguagus River Basin to the northwest, with a drainage area of 148 square miles, has been in operation since July 1929. The nearest stream gaging station to the east is located at Whitneyville, Maine, on the Machias River. This station has been in operation as a recording station since September 1929, and as a non-recording chain gage station from October 1903 to September 1921. It has a drainage area of 457 square miles.

16. The maximum rate of discharge at the Amherst station during its period of record was about 4,140 c.f.s. (28.0 c.f.s. per square mile) in April 1940 and the minimum rate was 3.6 c.f.s. in September 1941. At Whitneyville the maximum and minimum rates were 11,100 c.f.s. (24.3 c.f.s. per square mile) in September 1909 and 3.5 c.f.s. in October 1939, respectively. The average rate of runoff at Amherst is 264 c.f.s. or 1.79 c.f.s. per square mile, and at Whitneyville it is 955 c.f.s. or 2.08 c.f.s. per square mile.

17. A review of the records at six other gaging stations located within 50 to 80 miles of Cherryfield reveals that the maximum discharge at five of the stations occurred in the flood of 1 May 1923. At the sixth station the maximum discharge occurred on 29 September 1909 but this maximum was only two percent greater than the highest discharge experienced in 1923.

18. Floods of Record. - The three damaging floods of record on the Narraguagus River occurred on or about 9 March 1942, 20 March 1936, and 1 May 1923. Owing to the lack of gaging stations no data are available whereby the runoff can be computed for each flood. The maximum stage of record at Cherryfield was reached in March 1942 when the water was 5'-2" deep on the main floor of the bank building which is located about 175

feet above the east end of the lower highway bridge. This is about 9.5 feet above ordinary freshet stage or 11 feet above extreme high tide. In 1936 a recorded depth of 1'-11" on the bank floor was experienced. Both the floods of 1936 and 1942 were affected by ice conditions and stages were probably further augmented by the failure of three dams upstream. The flood of May 1923, which was caused entirely by heavy runoff, reached a stage approximately 3 feet below that of 1936. It has been reported that Stillwater Dam, the uppermost of four dams then in operation near Cherryfield, failed at this time and added to the experienced flood stage. The records at gaging stations in nearby watersheds indicate that the Narraguagus River discharge on 1 May 1923 was among the greatest experienced in this basin.

19. In January 1945 Cherryfield was faced with the threat of another serious flood when an ice jam formed on the frozen flats downstream from the lower highway bridge. The river rose rapidly and flooded several cellars. Serious damage was averted, however, by resorting to the use of dynamite to break the jam. Dynamite was also employed to partially relieve the serious jam of 1942 and a minor jam that occurred in 1944.

20. Hydraulic computations indicate that the bank-full capacity of the Narraguagus River at Cherryfield is about 12,000 c.f.s., assuming the absence of ice. Based on an interpolation of frequencies derived from gaging station records at Amherst and Whitneyville, a discharge of 12,000 c.f.s. at Cherryfield is extremely rare, having an estimated frequency of about once in 500 years.

21. The frequency of damaging ice jam floods cannot be ascertained with any degree of accuracy owing to the fact that ice jam experiences have coincided with dam failures. Local residents report that under present conditions the recurrence of ice jams has been much more frequent. When the dams were in existence the ponds retarded the flow of ice and

retained the ice until it rotted away. The former reservoir at Stillwater just above Cherryfield was especially effective in this respect.

22. Extent and Character of Flooded Area. - The ice jam flood of March 1942 inundated an area of approximately 65 acres in the commercial and residential center of Cherryfield, Maine. About 21 homes and 22 commercial and public buildings, having an estimated valuation of \$250,000, are located within this area. The commercial buildings include one hotel, a radio store, two jewelry stores, a drug store, a paint store, four general grocery stores, a large garage and automobile salesroom, and the offices of two local business concerns. A post office, a bank, and two halls owned by fraternal organizations constitute the principal public buildings affected. Main Street, which parallels the river on its east bank for a distance of nearly one mile was eroded. U. S. Highway No. 1, which crosses the flooded area from east to west near its lower end, was also damaged. Communication and power services were disrupted for several days by the loss of poles and lines. The total damage in 1942 is estimated at \$132,000. This figure includes \$25,000 for the loss of three dams in the one-mile reach of river above the flooded area, other non-recurring losses, and \$37,000 for indirect losses. One life was lost in the 1942 flood.

23. The flood losses, both direct and indirect, for the three floods of record since 1923, are estimated to have totaled about \$157,000, an average of \$6,500 annually. Average annual recurring losses will probably be less than this figure as the experienced losses reflect damage to several dams which have not been reconstructed. Furthermore, future flood stages will not be augmented by the surge resulting from the failure of dams upstream as were the stages of past floods. However, the frequency of flood occurrences will be greater in the future than in the past owing to the fact that the former dams, which retarded the flow of ice, no longer exist.

24. Existing Flood Control Projects. - There are no existing War Department projects for the control of floods on the Narraguagus River.

25. Improvements by Other Federal and Non-Federal Agencies. - No works have been constructed on the Narraguagus River solely for flood control purposes by any Federal or non-Federal agency. Private interests formerly operated five small rock-filled timber dams within the one-mile reach above the center of Cherryfield. Four of the dams were used for power purposes in connection with the once flourishing lumbering industry of the community and one was used for the generation of power for local consumption. The first annual report of the State Water Storage Commission, dated January 1911, stated that the power development at that time was about 500 horsepower. None of the dams are now in existence. Three were destroyed by ice in the flood of March 1942 and were not rebuilt, one was partially destroyed by fire in 1937, and one was abandoned over 30 years ago. See Plate No. 2 accompanying this report.

26. Improvement Desired. - A public hearing was held in Cherryfield, Maine on 6 May 1947, to determine the improvement desired, obtain data and afford interested parties an opportunity to express their views on the matter. The hearing was attended by about 110 people including a large number of local residents and business men and representatives of the State Highway Commission, the local County Chamber of Commerce, the railroad and the public utility company serving the area. The Board of Selectmen of Cherryfield presented the plan of improvement desired by local interests. They expressed a desire "that a flood control dam be installed in the river for the purpose of controlling the flood waters of the Narraguagus River in such manner that the danger of future floods will be eliminated." It was stated that the construction of a low dam at the Stillwater site would be effective in controlling ice jam floods and preventing damage at Cherryfield. No objections to the improvement were expressed.

27. The proponents claimed that some form of flood protection was necessary in order to maintain the present economic welfare of Cherryfield. Justification for improvement was based chiefly on the flood experiences of 9 March 1942. The loss sustained at that time was set by the townspeople at over \$104,000, this figure being supported by the returns from an extensive flood loss survey conducted by town officials. Other floods were reported in 1923, 1936, 1944 and 1945.

28. It was stated that the need for protection against ice jam floods had arisen as the result of the destruction in 1942 of the privately owned dams above Cherryfield, especially the uppermost dam at Stillwater. Stillwater dam created a shallow reservoir of about 330 acres which retained the ice in the Spring until it melted and disappeared in a normal manner without causing any serious ice jam problem. The residents of Cherryfield maintain that with the dams gone they are now faced with the threat of an ice jam flood each Spring and that serious jams may be expected to occur at intervals of four to eight years.

29. It was requested by a former member of the Atlantic Salmon Commission of Maine that consideration be given to a multiple-purpose reservoir which would improve low-water flow in dry periods during the time of salmon runs. The Narraguagus River is one of the best salmon rivers on the eastern coast of the United States.

30. Representatives of the town government stated at the hearing that it was not possible for them to make any definite commitments at this time regarding local cooperation. They have gone on record, however, as being ready to recommend to the citizens of Cherryfield that the town furnish all necessary lands and rights-of-way; hold and save the United States free from all claims for damage growing out of or incidental to the construction work; and agree to take over the protective works upon their completion and to maintain them in accordance with rules established by the Secretary of War. In addition, an appropriation of

\$2,500 that was made by the State "to aid in construction of piers at Stillwater on the Narraguagus River for protection of two concrete bridges - - -" can be applied as local cooperation towards a Federal project for providing protection against ice jams.

31. Discussion. - Flood damage in Cherryfield has been considerable in amount relative to the value of the property affected. Direct and indirect losses from high water and ice in the flood of March 1942 are estimated at \$130,000 based on an analysis of data presented by local interests. One life was lost. Making allowance for dams and buildings which were destroyed by the flood and not replaced, recurring losses are estimated at \$105,000 for a flood stage equal to that of March 1942.

32. Damage at Cherryfield is caused by ice conditions in the spring freshet season. The principal floods of record were of the ice jam type and were attributable in part to the failure of Stillwater Dam which caused a sudden release of the ice and water retained in the reservoir. The released ice formed a jam on the frozen flats a short distance downstream from the lower highway bridge in Cherryfield. The river was backed up by the jam until water and ice overflowed the banks of the stream and flooded the center of the town. Computations indicate that the discharge capacity of the river channel at Cherryfield is adequate for usual flood flows without ice. Evidence of this is provided by the flood of May 1923 which caused only slight damage although it was the major flood in adjacent watersheds.

33. Ice conditions are a major factor in the regimen of the Narraguagus River. Surface ice generally forms 18 inches to two feet thick on the upper river and its tributaries, and on the lakes or ponds within the basin during the winter months. The fast, turbulent water in the rapids at Cherryfield is especially conducive to the formation of frazil ice in large quantities. Due to the high density of frazil ice as compared with sheet ice, which contains entrained air, the frazil ice submerges readily and eventually accumulates underneath the sheet ice

cover. This probably accounts for the reported ice thickness of seven to eight feet at the upper end of the 4-1/2-mile tidal reach between Cherryfield and Millbridge. The ice conditions at Cherryfield are further aggravated by the formation of anchor ice. The natural ponds and reservoirs in the Narraguagus River Basin tend to diminish the quantity of ice in the lower reaches of the river as little or no frazil ice passes through the pools and the sheet ice is retained within the reservoir areas until it rots away or until after the break-up of the ice downstream.

34. The destruction of the small dams near Cherryfield, especially the dam at Stillwater, has resulted in conditions more favorable to the formation of ice jams at Cherryfield. This is the contention of local interests and it is borne out by the increased number of jams experienced since 1942.

35. Protection against the formation of ice jams at Cherryfield may be provided by several means, as described below.

a. The construction of a low dam at Stillwater as proposed by local interests would reestablish the former Stillwater Reservoir. This would cause ice jams to form at the head of the pool and would be effective in retaining ice in the pond until after the break-up of the ice in the tidal reach between Cherryfield and Millbridge.

(1) An overflow dam at Stillwater, approximately 300 feet long and with a maximum height 10 feet above the stream bed, would form a reservoir of 330 acres extending two miles up the Narraguagus River and about the same distance up its West Branch. There are no existing developments or farmland within the reservoir area. A small fishway would be required at the dam.

(2) The storage capacity of the full reservoir would be about 2000 acre feet or about 0.2 inches of storage on the tributary drainage area of 228 square miles. Gates would be operated to maintain

a pool in the winter season, so that the storage available for reducing flood flows would be limited to spillway surcharge storage.

(3) The initial cost for a dam of concrete construction would be high in comparison with the value of the property protected. The ratio of annual benefits to annual costs, however, is more favorable. A dam of rock-filled timber construction, or a rock-filled dam with a concrete slab on the upstream face, could be constructed at less initial cost and would afford substantially the same benefits as a concrete structure.

b. A permeable barrier of random rubble construction at Stillwater would be effective in retarding the downstream flow of ice during thaws and thereby prevent the formation of ice jams at critical locations near the lower limit of residential and commercial properties in Cherryfield. An ice barrier of this type could be constructed for approximately one-third the cost of a concrete dam without any considerable reduction in benefits.

c. The construction of a barrier, consisting of a heavy trash rack arrangement of steel piling across the stream, would also retard the flow of ice and create a jam above the town where no damage could be caused by backwater. The initial and annual costs for such a structure would be within economically justifiable limits. Although the barrier would collect trash and be unsightly, it should not be objectionable owing to its remote location.

36. Flood losses in Cherryfield could also be prevented by the construction of dikes along both banks of the river. Over one mile of dikes would be required and the relocation of several buildings would be necessary. This would be a costly and uneconomical method of securing protection for the town. The cost of the dikes would approach the value of the property to be protected.

37. Damage from ice jam floods could be eliminated or greatly re-

duced by the employment of annual remedial or preventive measures in lieu of the construction of protective works. One method is to use explosives such as dynamite or thermit to destroy ice jams when they occur. The second method is to prevent the occurrence of jams by securing and maintaining an open channel in the lower section of the river by means of calcium chloride and other chemicals which accelerate the deterioration and break-up of ice in the Spring, a method that has been used elsewhere with some success. It should be practicable to relieve or prevent serious ice jams on the Narraguagus River by preventive measures at about one-half the annual cost of a concrete structure.

38. The benefits of complete protection against ice jam floods are conservatively estimated at \$6000 annually based on 1942 valuations. In comparing benefits with costs, however, the present high level of prices should be kept in mind. In addition to the benefits to be realized from the prevention of direct and indirect losses, other benefits will be obtained, such as the prevention of loss of life, which are not susceptible of dollar evaluation. The general welfare of the community will be enhanced if suitable protection against recurring ice jam floods is provided.

39. Multiple-purpose use of a reservoir at Stillwater has been given limited consideration for reducing flood flows, increasing low-water flow during the salmon season, recreation, power development and water supply.

a. The low dam proposed for ice control would create a reservoir of about 330 acres, having a capacity of about 2000 acre feet. This pool could be drawn down during the months of June and July to increase the flow in drought periods when there is insufficient water to permit the salmon to swim upstream. An increase in discharge of about 25 percent would be obtained over a two-month period. An alternate method of operation would be to retain the pool at constant level for recreational purposes.

b. The Stillwater site appears from inspection to be suitable for the construction of a dam 30 to 40 feet above the stream bed. Twelve or more sets of buildings and about five miles of highway would be affected. The capacity of such a reservoir would be over 50,000 acre feet or 4.0 inches on 228 square miles of drainage area. This capacity is not required or justified for the present flood control needs of Cherryfield. Power storage at the site in conjunction with a penstock and power station one mile downstream from the dam to obtain a gross head of 80 feet or more would develop the power potentialities of the lower Narraguagus River. No investigation has been made of the cost or economics of power development, which does not appear particularly attractive, and is not desired by local interests. The provision of water supply in a multi-purpose project is desired by the town of Cherryfield although it is not in a position to finance such a project. It is believed that the cost of a multiple-purpose development would exceed the benefits derived.

40. Conclusions. - It appears that damage in Cherryfield from floods caused by the formation of ice jams on the Narraguagus River may be prevented or reduced in a practical manner by (1) the construction of a low dam at Stillwater, (2) an ice control structure, or (3) annual preventive measures by an ice patrol team. The value of complete protection is estimated at \$6,000 annually. It is believed that control works or remedial measures may be provided at a cost commensurate with the prospective benefits.

41. Recommendations. - The Division Engineer recommends that a survey and estimates of cost be made in order to determine a suitable plan to prevent or control damaging ice jam floods on the Narraguagus River at Cherryfield, Maine, and the economic justification thereof.

R. G. MOSES
Brigadier General, U.S.A.
Division Engineer

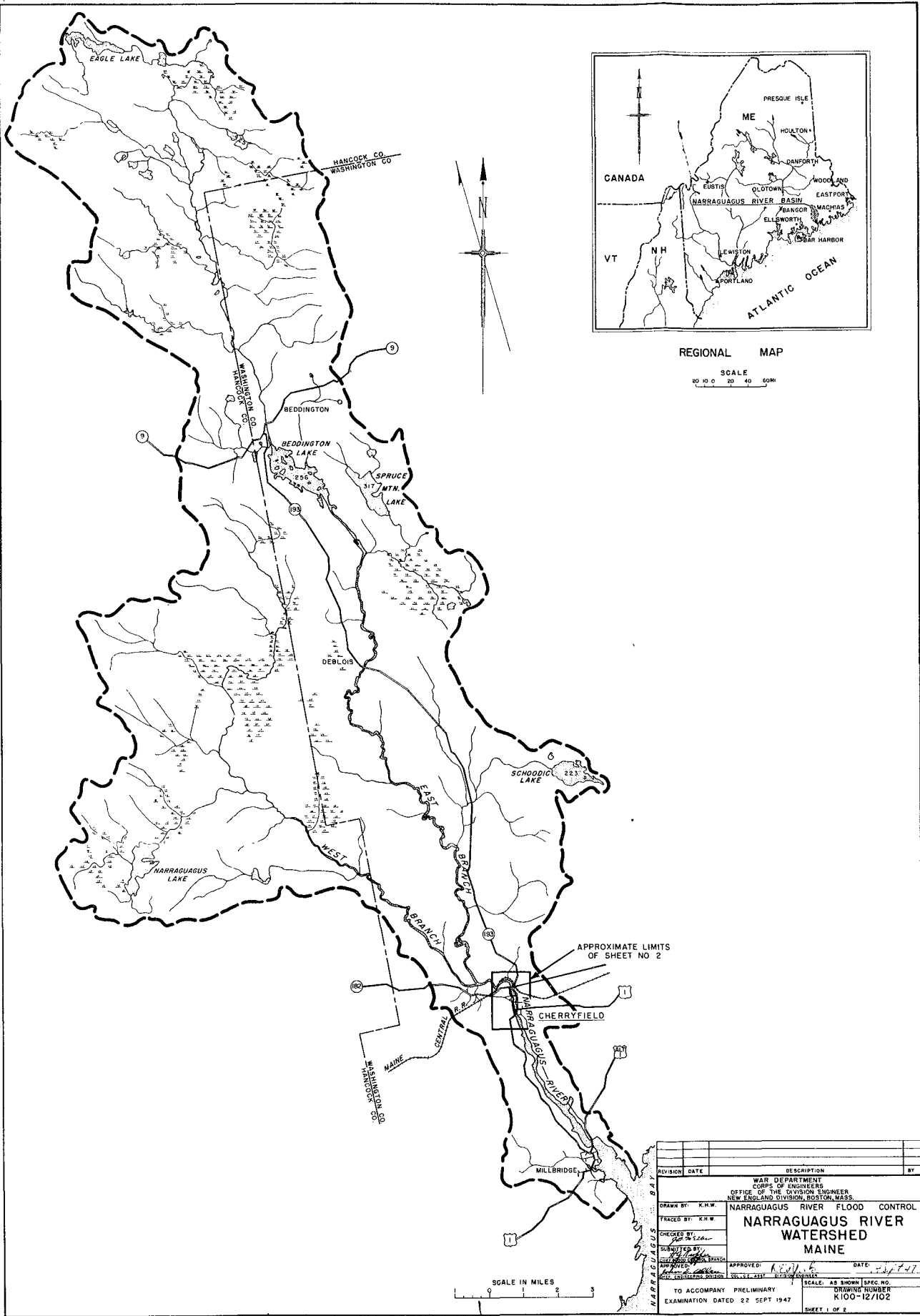
Inclosures:

Plate No. 1 - Plan of Narraguagus
River Watershed, File No. K100-12/102.

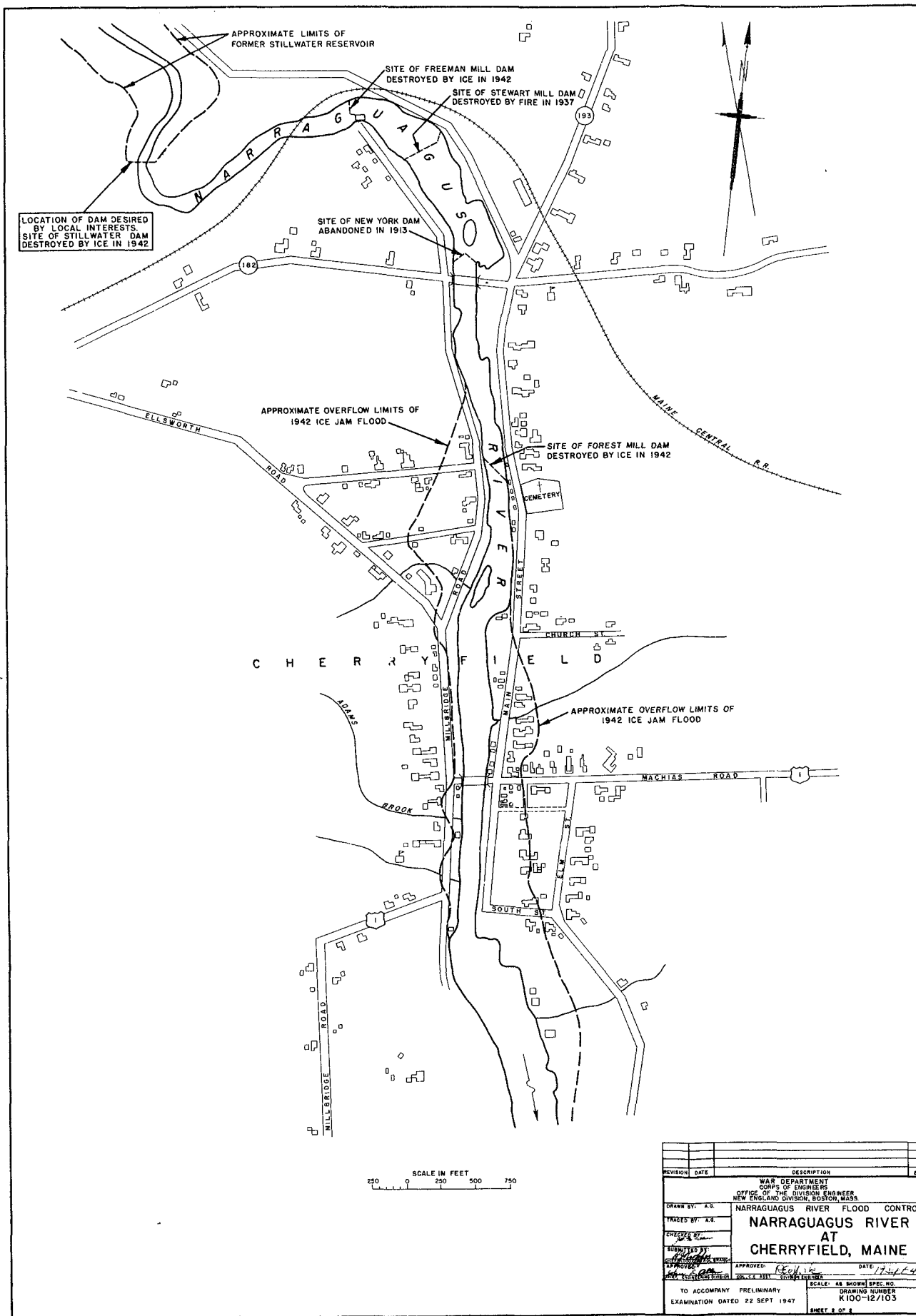
Plate No. 2 - Plan of Narraguagus
River at Cherryfield, Me., File No. K100-12/103,
(Under separate cover):

Record of Hearing, in trip.

Tracings of Plans, File Nos. K100-12/102 and K100-12/103.



REVISION	DATE	DESCRIPTION	BY
WAR DEPARTMENT CORPS OF ENGINEERS OFFICE OF THE DIVISION ENGINEER NEW ENGLAND DIVISION, BOSTON, MASS.			
NARRAGUAGUS RIVER FLOOD CONTROL			
NARRAGUAGUS RIVER WATERSHED MAINE			
DRAWN BY: K.H.W.		DATE: 8-27-47	
CHECKED BY: J.W. L...		APPROVED: [Signature]	
SUBMITTED BY: [Signature]		DATE: 8-27-47	
TO ACCOMPANY PRELIMINARY		SCALE: AS SHOWN (SPEC. NO. K100-12/102)	
EXAMINATION DATED 22 SEPT 1947		SHEET 1 OF 2	



REVISION	DATE	DESCRIPTION	BY
WAR DEPARTMENT CORPS OF ENGINEERS OFFICE OF THE DIVISION ENGINEER NEW ENGLAND DIVISION, BOSTON, MASS.			
DRAWN BY: A.S. TRAISED BY: A.S. CHECKED BY: <i>[Signature]</i> EXAMINED BY: <i>[Signature]</i> APPROVED: <i>[Signature]</i> DATE: 17 Sept 47			
NARRAGUAGUS RIVER FLOOD CONTROL NARRAGUAGUS RIVER AT CHERRYFIELD, MAINE			
TO ACCOMPANY PRELIMINARY EXAMINATION DATED 22 SEPT 1947		SCALE: AS SHOWN DRAWING NUMBER K100-12/103 SHEET 2 OF 2	